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Experimental and computational investigations of shock-accelerated gas bubbles

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A new experiment is being developed to study shock-induced motions and mixing at a gas interface. The experiments take place in a vertical, square shock tube, of large internal cross section (25 × 25 cm); the test gas is contained in a soap bubble (with diameter varying between 4 and 8 cm), either supported by an injector or freely moving (upwards or downwards, depending on the test gas density) inside the shock tube (shock-accelerated bubbles were first studied by Haas and Sturtevant (1987)). The initial interface is therefore three-dimensional, with axial symmetry being a reasonable assumption for a free rising (or falling) bubble. The strength of the accelerating shock is in the range $2 \le M \le 4$. The interface is imaged once immediately before shock arrival and twice after interaction with the shock wave, so that the initial conditions are known and growth rates can be calculated for each experiment. Planar Mie scattering and planar laser induced fluorescence are utilized to diagnose the flow.

Concurrently, the *Raptor* code is being used to numerically simulate the shock tube runs for the purpose of optimizing the design of the experiments and for comparing the experimental to the numerical results. The code solves the compressible Navier-Stokes equations using a piecewise linear method (PLM) combined with adaptive mesh refinement (AMR).

An example of calculation and experimental results are shown in Fig. 1 and we will report growth and mixing rates for different values of the Atwood and Mach numbers.

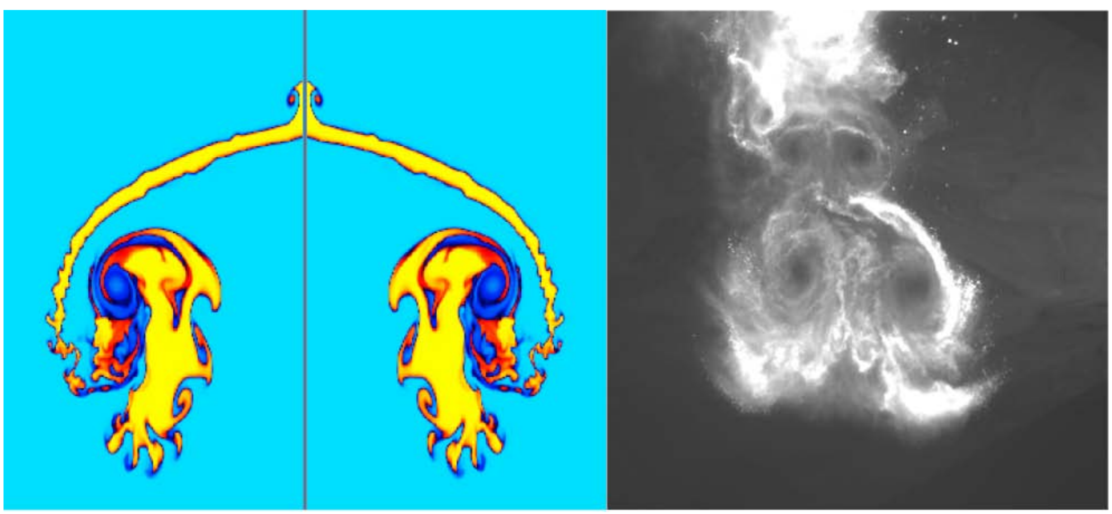

Figure 1: Ar bubble in air; $M = 2.14$; $t = 1.2$ ms after shock-bubble interaction. Left: computational air mass fraction. Right: planar Mie scattering image.

Reference References

J.F. Haas and B. Sturtevant, Interaction of weak shock waves with cylindrical and spherical gas inhomogeneities. JFM 41-76, 1987.